



National Aeronautics and Space Administration

NASA Research to Support the Airlines

Richard Mogford, Ph.D.
NASA Ames Research Center





Examples of NASA Aeronautics Projects

- Airline Operations Workshop
- NASA/Airline industry forum
- Flight Awareness Collaboration Tool
- Dispatcher human factors study
- Airline Operations Research Group
- Infrasound-based turbulence detection
- Incursion detection in aircraft safety zone
- Dynamic Weather Routes
- Traffic Aware Strategic Aircrew Requests

Airline Operations Workshop

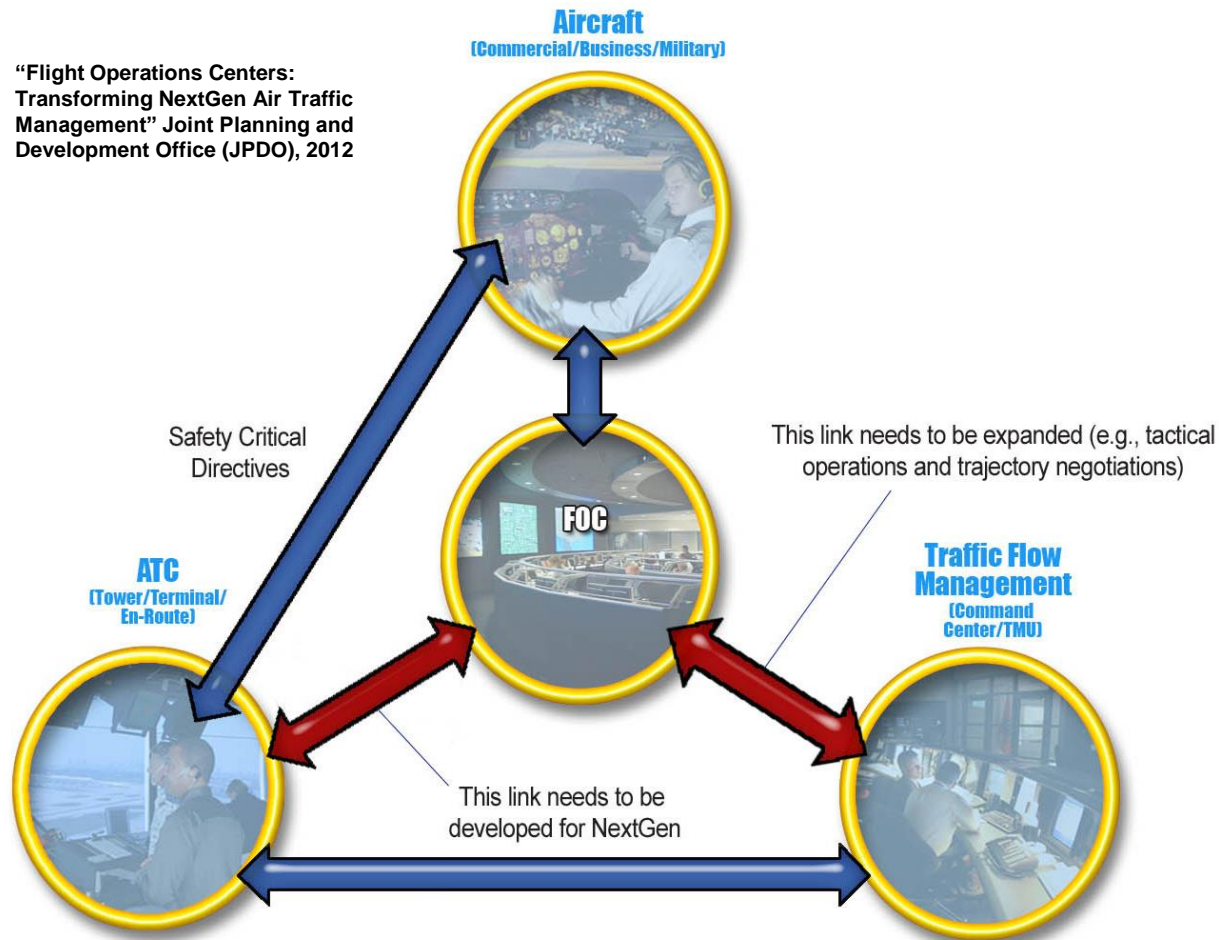


- Held an Airline Operations Workshop at NASA Ames in August 2016
 - About 200 attendees - airlines and airline software vendors, NASA, FAA, and academia
 - Focused on NASA, FAA, and private sector innovations to support the airlines (AOC and flight deck)
 - Identified gaps where research is needed
 - Formed partnerships with airline industry
- Research themes
 - AOC simulation
 - Study dispatcher workload, situation awareness, errors
 - Display/system integration
 - Managing/accessing large information databases from multiple sources
 - Preferred routes

Emphasis on Airline Operations




“Flight Operations Centers:
Transforming NextGen Air Traffic
Management” Joint Planning and
Development Office (JPDO), 2012



FOC = flight operations center

NASA/Airline Industry Forum



 NASA AORG

My account Log out

Home

[Home](#) » [Forums](#) » [General discussion](#)

First topic!

View Edit Delete








Submitted by [admin](#) on Wed, 04/19/2017 - 00:51


Forums
[General discussion](#)


Add new comment

Subject

Comment *

B **I**      Format   Source

Text format Basic HTML 

[About text formats](#) 

Save Preview

Search

Tools
[Add content](#)
[Forums](#)

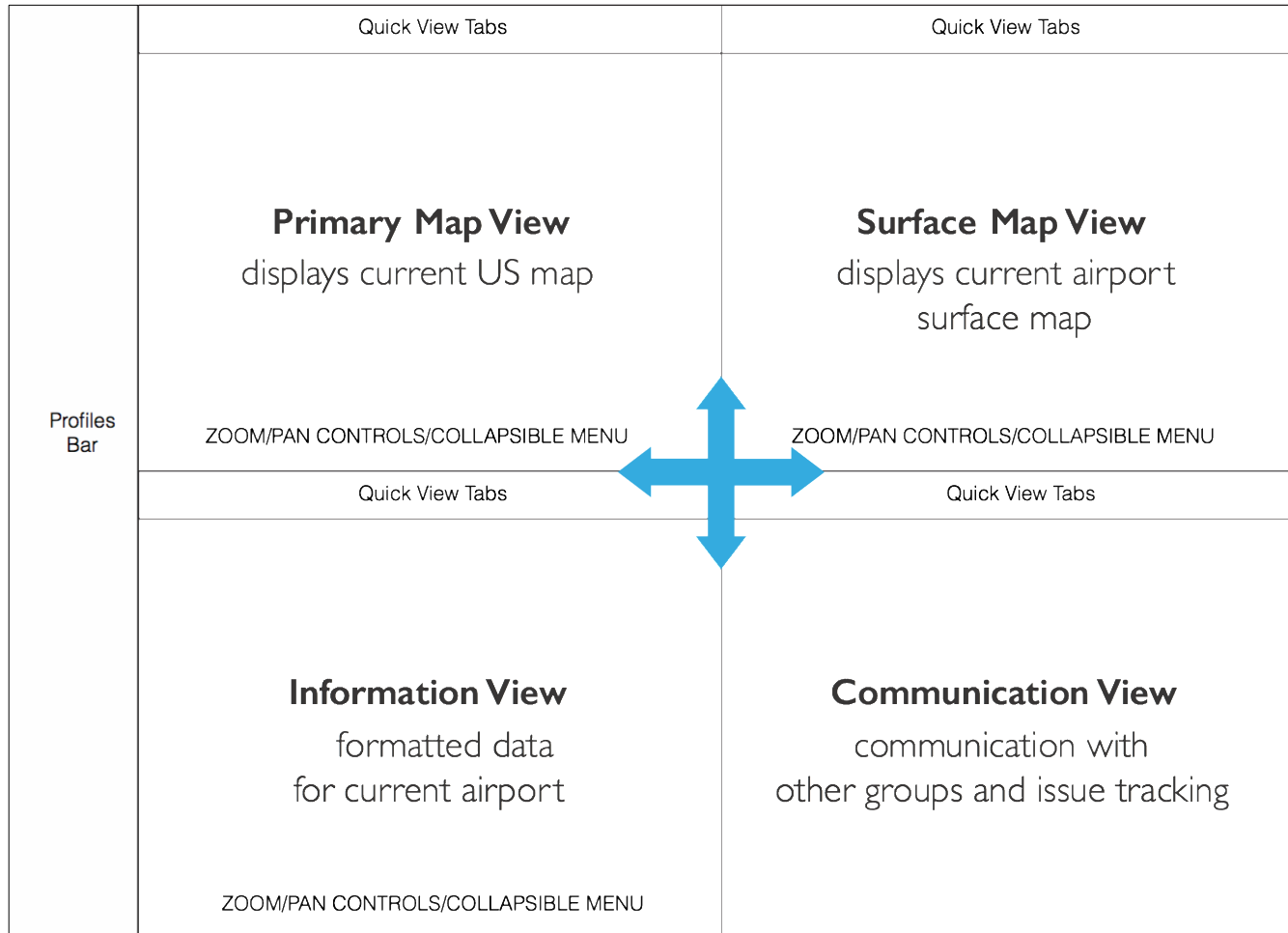
Being created to support airline industry and NASA technical discussions

Flight Awareness Collaboration Tool



- Developing the “Flight Awareness Collaboration Tool” (FACT)
- Concentrates information about winter weather events on one display
- Includes predictive tools
- Supports collaboration between AOC, air traffic control, airport authority, and de-icing operators
- Web-based application
- Includes:
 - Weather status and forecasts
 - FAA Winter Weather Dashboard
 - Prediction/reporting of runway closures for snow/ice treatment
 - Runway braking action
 - Airport runway configuration (capacity)
 - De-icing operations
 - FAA actions (e.g., ground stops, miles-in-trail, etc.)

FACT Design



FACT User Interface



The screenshot displays the FACT User Interface, which is divided into several sections. On the left, there is a sidebar with a user profile icon, a search bar, and a list of airport codes (SEA, PDX, SFO, SJC, LAS, SAN, PHX, DEN, MSP, ORD, MDW, IND, CNG, PIT, EWR, PHL, BOS, LGA, JFK, TEB, IAD, DCA, MEM, BNA, RDU, ATL, MCO, TPA, FLL, MIA). Below this, there are tabs for 'PRIMARY MAP', 'QUICKVIEW 1', 'SURFACE', and 'QUICKVIEW 1'. The 'PRIMARY MAP' tab shows a map of the United States with various airport codes. The 'SURFACE' tab shows a detailed view of an airport terminal. A yellow arrow points from the 'BOS LGA JFK' area on the map to the 'SURFACE' view. Another yellow arrow points from the 'BOS LGA JFK' area on the map to the 'FACT CHAT' section. The 'FACT CHAT' section contains a list of advisories and a search bar. The 'ATCSCC ADVISORIES FOR WEDNESDAY, 06-10-2015' section contains a table of advisories.

#	Control Element	Date	Brief Title	Send
004	FCAA16	06/10/2015	CDM Airspace Flow Program CNX	06/10/15 00:18
003	ATL/ZTL	06/10/2015	CDM Ground Delay Program	06/10/15 00:14
002	LGA/ZNY	06/10/2015	CDM Ground Delay Program CNX	06/10/15 00:13
001	DCC	06/10/2015	Reroute Cancellation	06/10/15 00:05

ATCSCC ADVISORIES FOR WEDNESDAY, 06-10-2015

#	Control Element	Date	Brief Title
161	DCC	06/09/2015	Reroute Cancellation
160	DCC	06/09/2015	Reroute Cancellation

Quicklinks: ATCSCC ADVZ 160 DCC 06/09/15 Route RQD /FL ame: FLA_TO_NYMETROS

FACT CHAT

ADD QUEUE ITEM PRINT REPORT

15:30:02 LGA: Too many aircraft in de-icing area. AUTHOR: mgoford MORE RESOLVE SHARE DELETE

11:18:16 JFK: UAL 3740 stall in de-icing area. Expect a 20 min delay. AUTHOR: dpeknik LESS RESOLVE SHARE DELETE

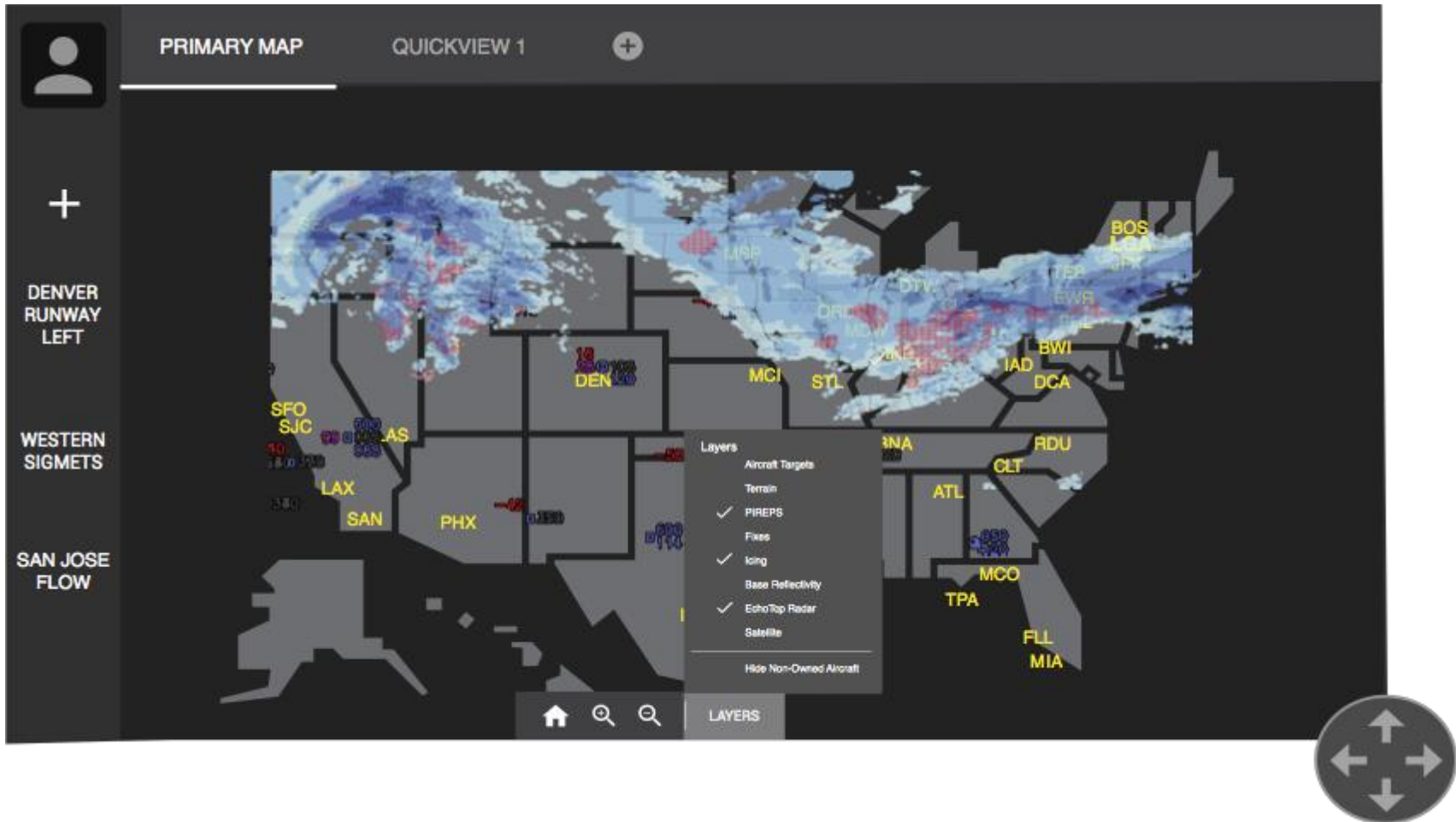
Comments:

13:30:45 dpeknik: There seems to be a stall in the de-icing area. Can we set a delay? I'll do the calls if needed. attachment REPLY

13:42:34 eleong: I say go for it.

13:42:34 mgoford: Let me check and see what our next crew roster says. REPLY

FACT Primary Map View



FACT Surface Map View



FACT Information View (Text)



PLANNING CHARTS QUICKVIEW 1 +

ATCSCC ADVISORIES FOR WEDNESDAY, 06-10-2015

#	Control Element	↓ Date	Brief Title	Send Time
004	FCAA16	06/10/2015	CDM Airspace Flow Program CNX	06/10/15 00:18
003	ATL/ZTL	06/10/2015	CDM Ground Delay Program	06/10/15 00:14
002	LGA/ZNY	06/10/2015	CDM Airspace Flow Program CNX	06/10/15 00:13
001	DCC	06/10/2015		06/10/15 00:05

ATCSCC ADVISORIES FOR WEDNESDAY, 06-10-2015

#	Control Element	Date	Brief Title
161	DCC	06/10/2015	
160	DCC	06/10/2015	DCC 06/09/15 Route RQD /FL

Quicklinks

✓

FAA OIS

✓

Aviation Weather Center

FAA NOTAMs

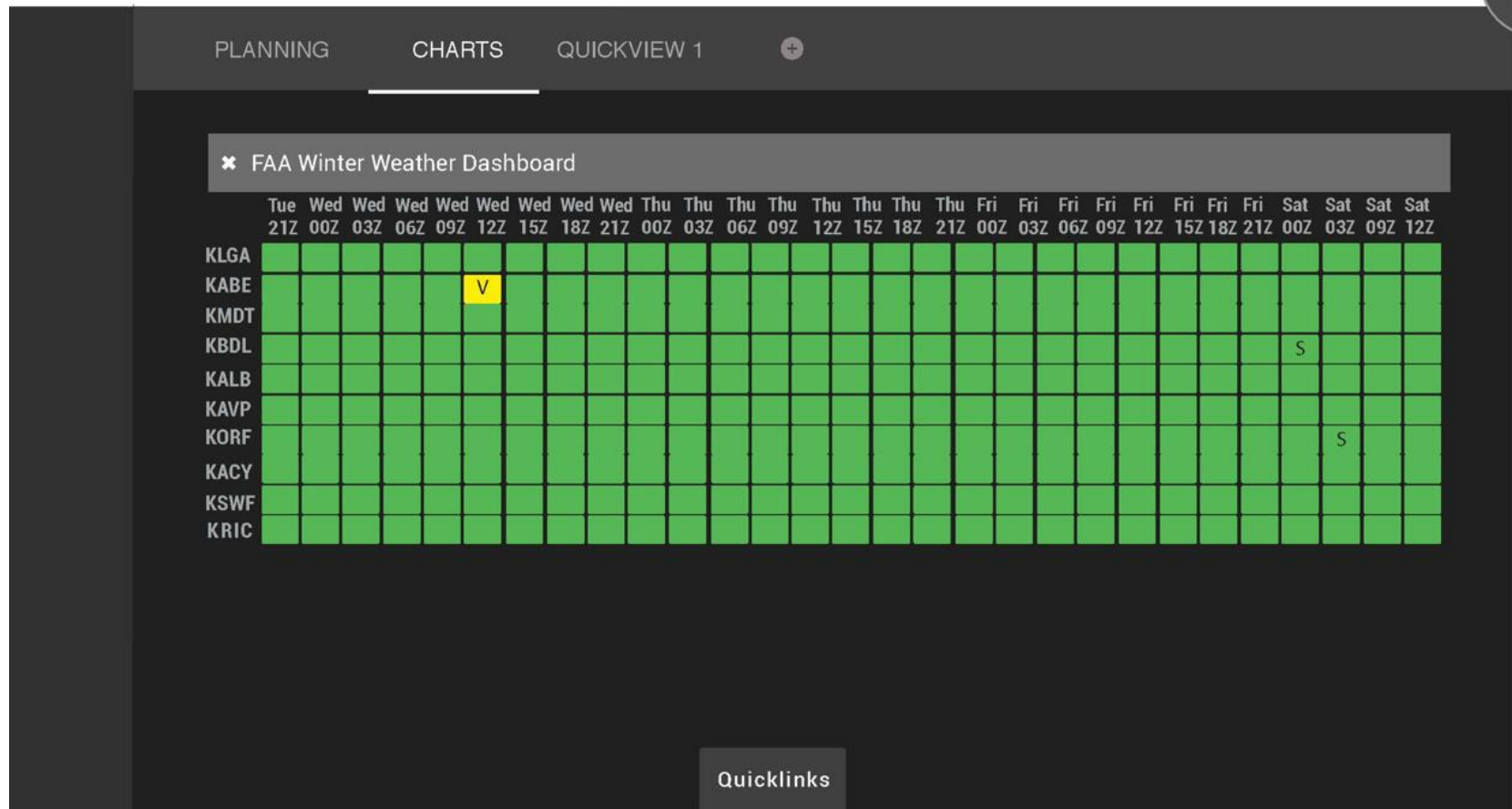
WWACM

Quicklinks

Name: FLA_TO_NYMETROS

Constrained area: ZJX/ZMA

FACT Information View (Graphics)



FACT Communication View



MY QUEUE **FACT CHAT** **+**

ADD QUEUE ITEM **PRINT REPORT**

LGA: Too many aircraft in de-icing area.

MORE

15:30:02

AUTHOR: **rmogford**

RESOLVE

SHARE

DELETE

JFK: UAL 3740 stall in de-icing area. Expect a 20 min delay.

LESS

11:18:16

SHARED WITH:

RESOLVE

SHARE

DELETE

Comments:

13:30:45

dpeknik: Not sure how to deal with this one, any suggestions?
Here's the procedure. **attachment**

REPLY

13:42:34

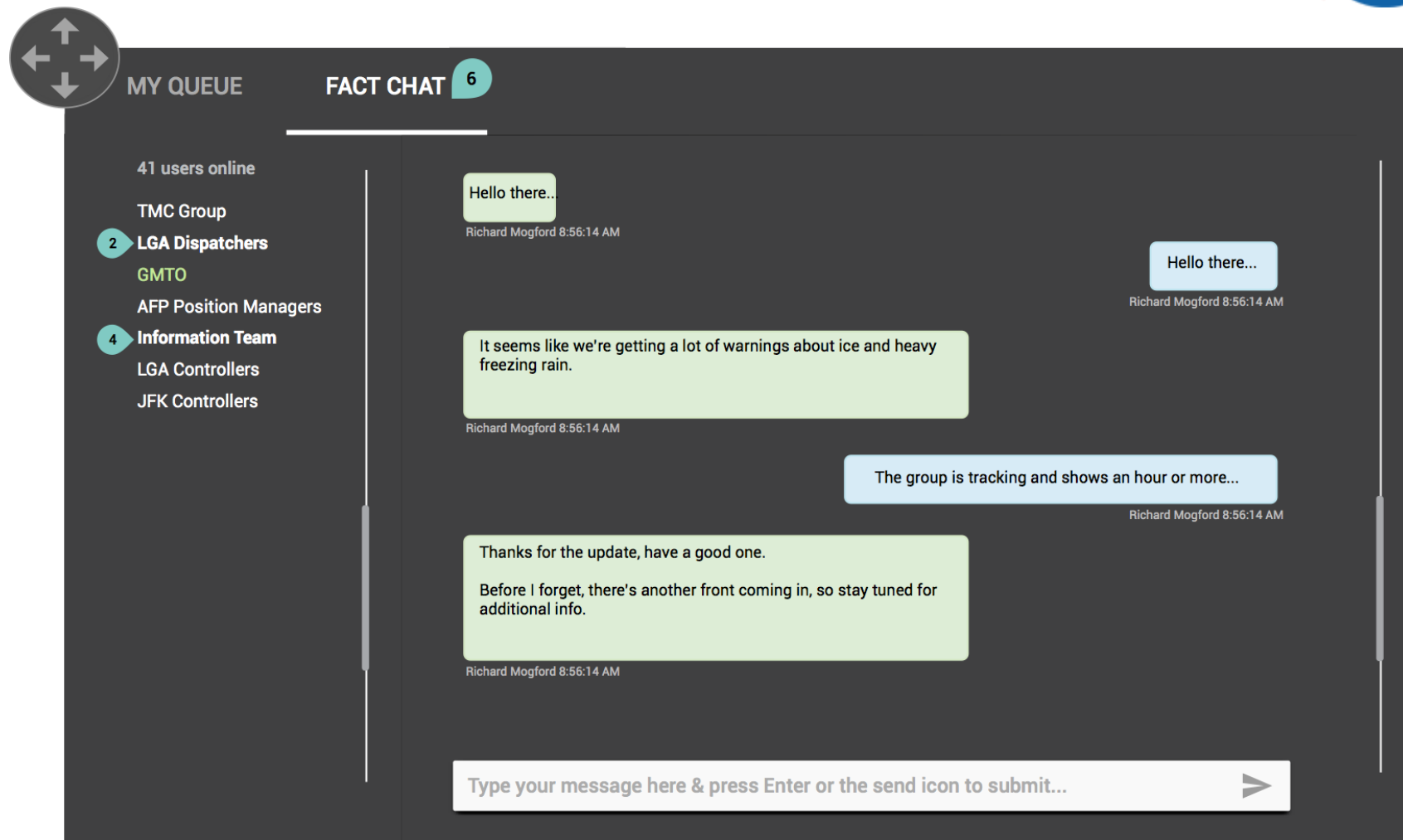
eleong: That's an old document I believe,.

13:42:34

rmogford: I'll update and send a new document to the team.

REPLY

FACT Communication View



The interface is a dark-themed chat application. At the top left is a circular icon with four arrows pointing up, down, left, and right. Below it, the header bar contains "MY QUEUE" and "FACT CHAT 6". The left sidebar lists user counts and group names: "41 users online", "TMC Group", "2 LGA Dispatchers GMT0", "AFP Position Managers", "4 Information Team", "LGA Controllers", and "JFK Controllers". The main chat area shows a conversation with "Richard Mogford" at "8:56:14 AM". The messages are: "Hello there..." (green bubble), "Hello there..." (blue bubble), "It seems like we're getting a lot of warnings about ice and heavy freezing rain." (green bubble), "The group is tracking and shows an hour or more..." (blue bubble), and "Thanks for the update, have a good one. Before I forget, there's another front coming in, so stay tuned for additional info." (green bubble). At the bottom is a text input field with the placeholder "Type your message here & press Enter or the send icon to submit..." and a right-pointing arrow icon.

MY QUEUE

FACT CHAT 6

41 users online

TMC Group

2 LGA Dispatchers GMT0

AFP Position Managers

4 Information Team

LGA Controllers

JFK Controllers

Hello there...

Richard Mogford 8:56:14 AM

Hello there...

Richard Mogford 8:56:14 AM

It seems like we're getting a lot of warnings about ice and heavy freezing rain.

Richard Mogford 8:56:14 AM

The group is tracking and shows an hour or more...

Richard Mogford 8:56:14 AM

Thanks for the update, have a good one.

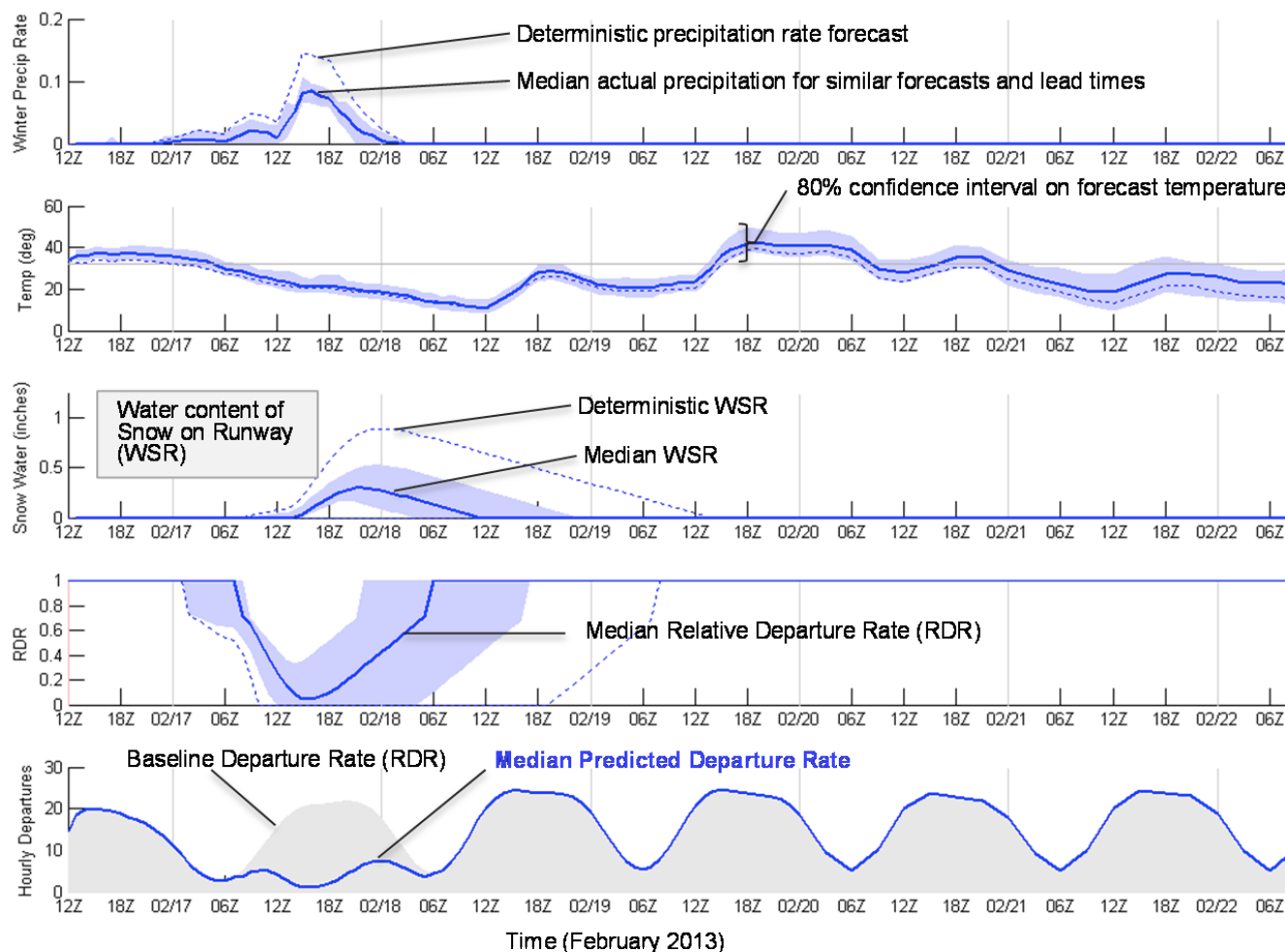
Before I forget, there's another front coming in, so stay tuned for additional info.

Richard Mogford 8:56:14 AM

Type your message here & press Enter or the send icon to submit...



Winter Weather Airport Capacity Model





FACT Status

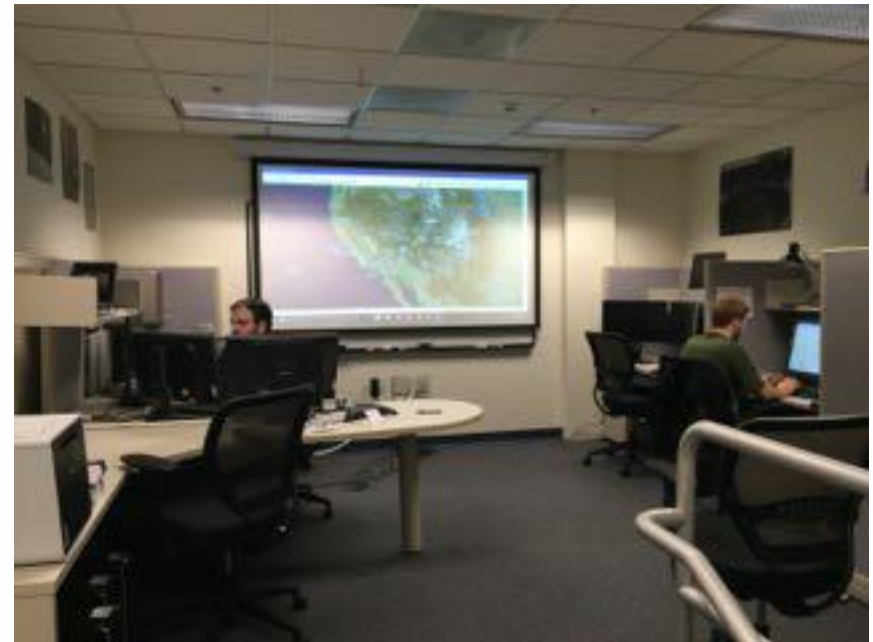
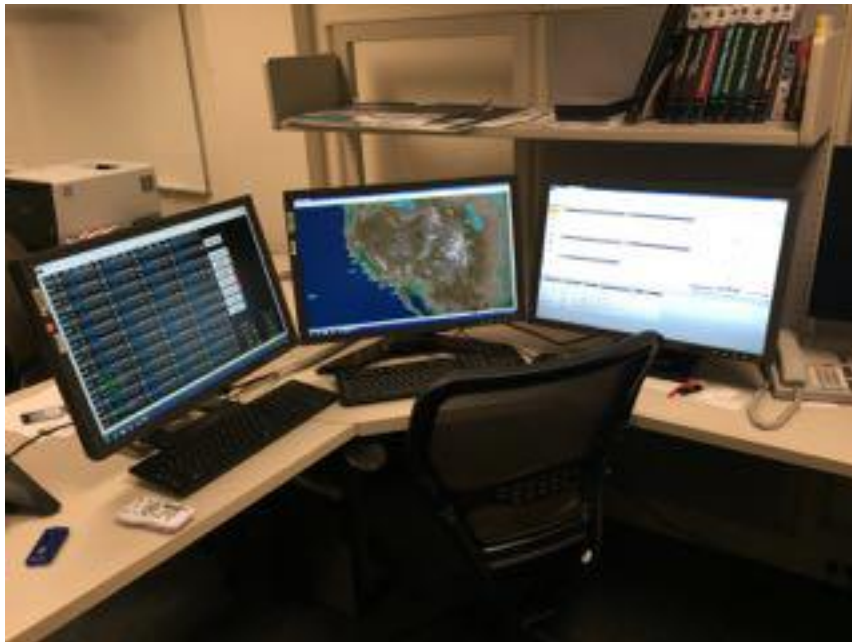
- User interface design completed and web-based prototype under development
- Winter Weather Airport Capacity Model being evaluated at several facilities
- User group at Detroit airport
- Plan to begin showing FACT to potential users to request feedback on functionality and user interface design
- Will visit US airlines to review FACT and other research issues

Dispatcher Human Factors Study



- Suggestions for a human factors study of dispatcher tasks at the Airline Operations Workshop
- Partnering with two major airlines
- Will visit AOCs to shadow dispatchers during various shifts across several days
- Trying to better understand the work of dispatchers in several configurations
 - Extended operations flights
 - Transcontinental flights
 - Weather events
- Will provide a basis for more detailed studies and better informed research

Airline Operations Research Group



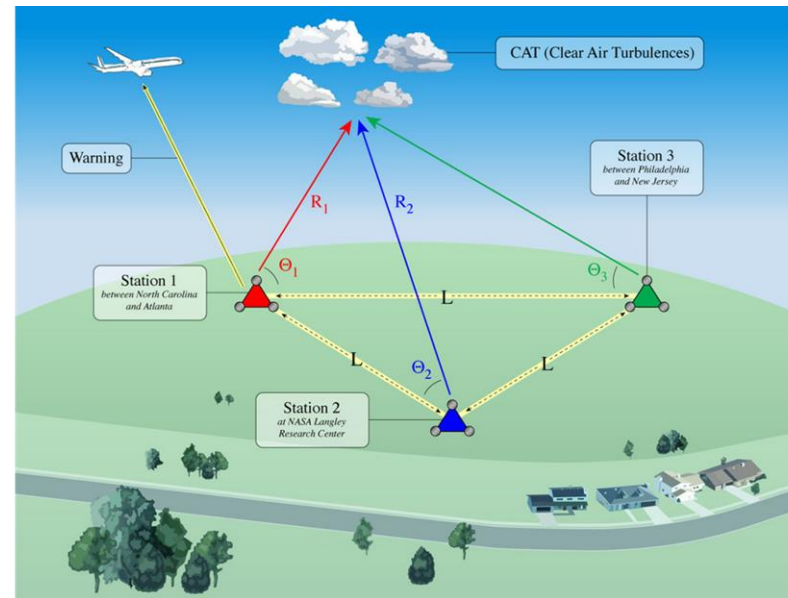
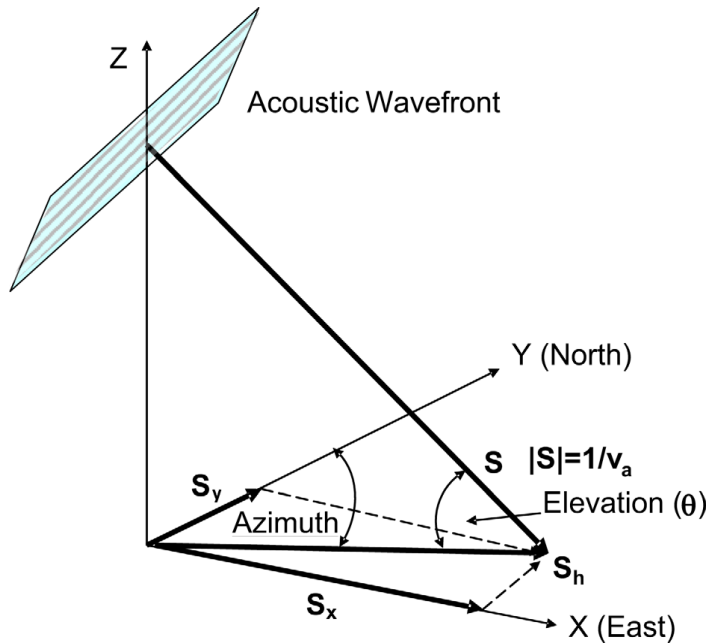
Laboratory created at NASA Ames

Infrasound-based Turbulence Detection Feasibility Study



- Partnering with University Corporation for Atmospheric Research to determine if clear air turbulence detection by infrasonic microphone arrays is feasible
- Study objectives:
 - What are the spectral characteristics of the acoustic energy?
 - How are the spectral characteristics of the acoustic energy related to turbulence intensity metrics that, in turn, can be related to aircraft response?
 - What are the transmission properties of the acoustic signal (i.e., attenuation, refraction, and diffraction) as the acoustic waves propagate from the source to the receivers?
 - Given the proposed geometries of a receiver array, what are the temporal and spatial accuracies that can be achieved?
 - What are the appropriate signal processing methods to ensure adequate detection and minimal false alarms?
- Dr. Qamar Shams at NASA Langley has an infrasound array set up
 - Second array needed to test localization

Acoustic Array

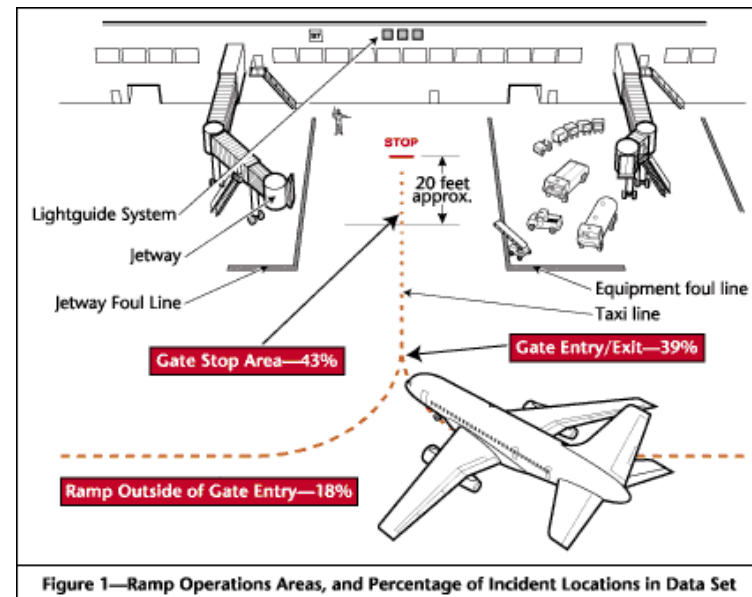
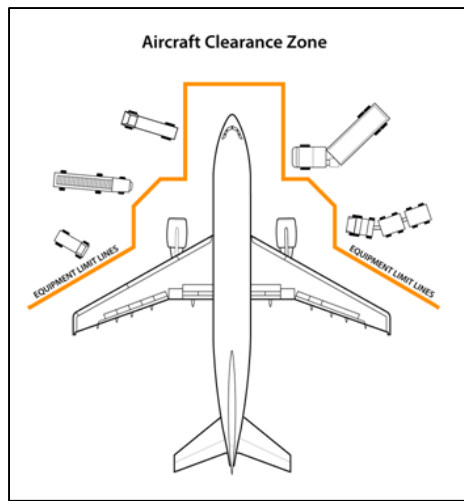


Microphone Array and Detection Example

Incursion Detection in Aircraft Safety Zone



- How to reduce ground vehicle incidents?
 - Will analyze ramp area video recordings provided by partner airlines
 - Determine if ground vehicle incursion into aircraft safety zone can be reliably detected



Incursion Detection in Aircraft Safety Zone





Dynamic Weather Routes (DWR)

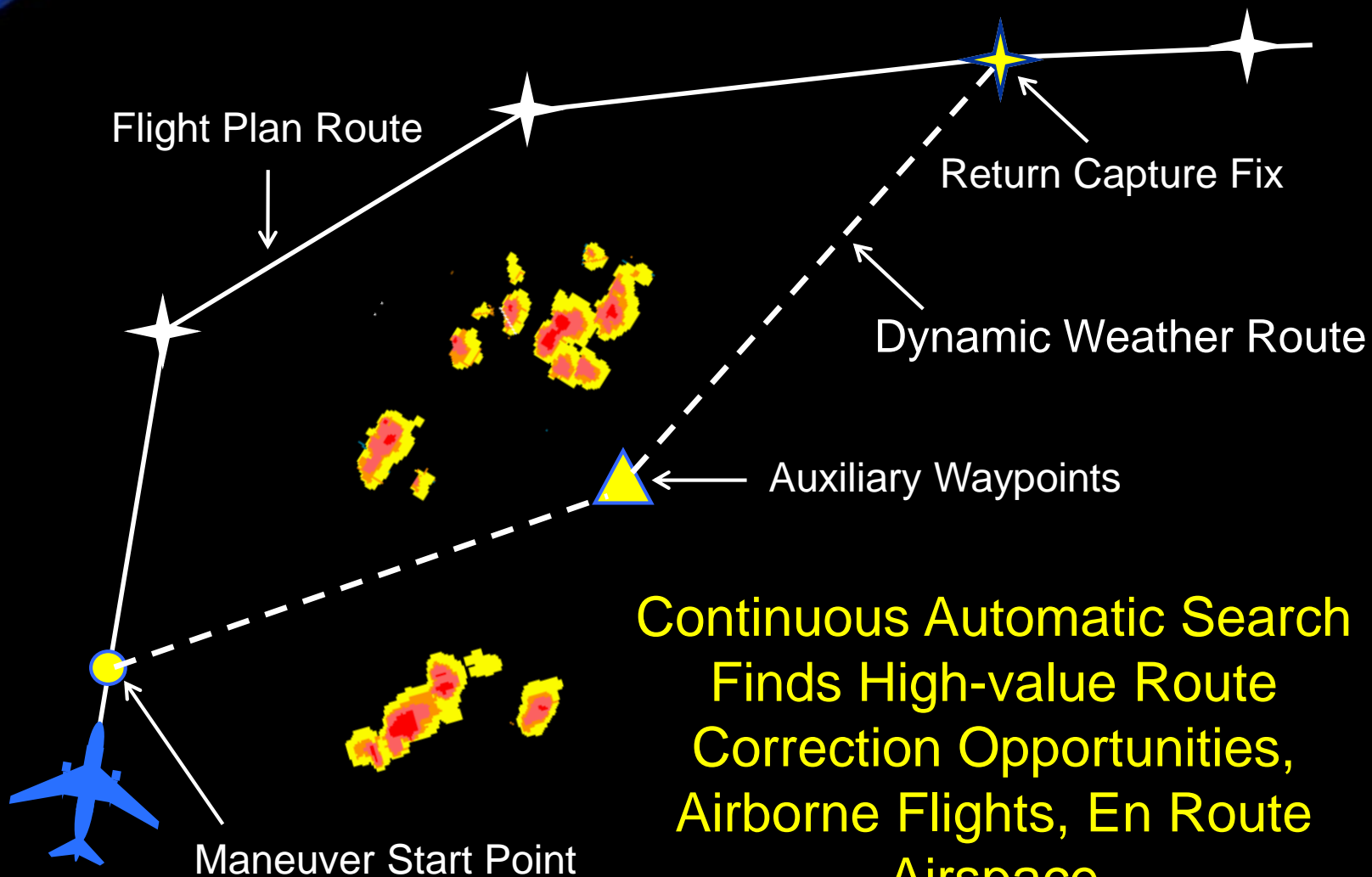
What's the Problem?

- Convective weather cells, or severe thunderstorms, are leading cause of flight delay in US airspace
- Flight dispatchers file flight plans 1-2 hours prior to departure utilizing routes with conservative buffers to severe forecast weather

- Weather changes as flights progress
- No automation to help operators determine when weather avoidance routes have become stale and could be corrected to reduce delay



DWR

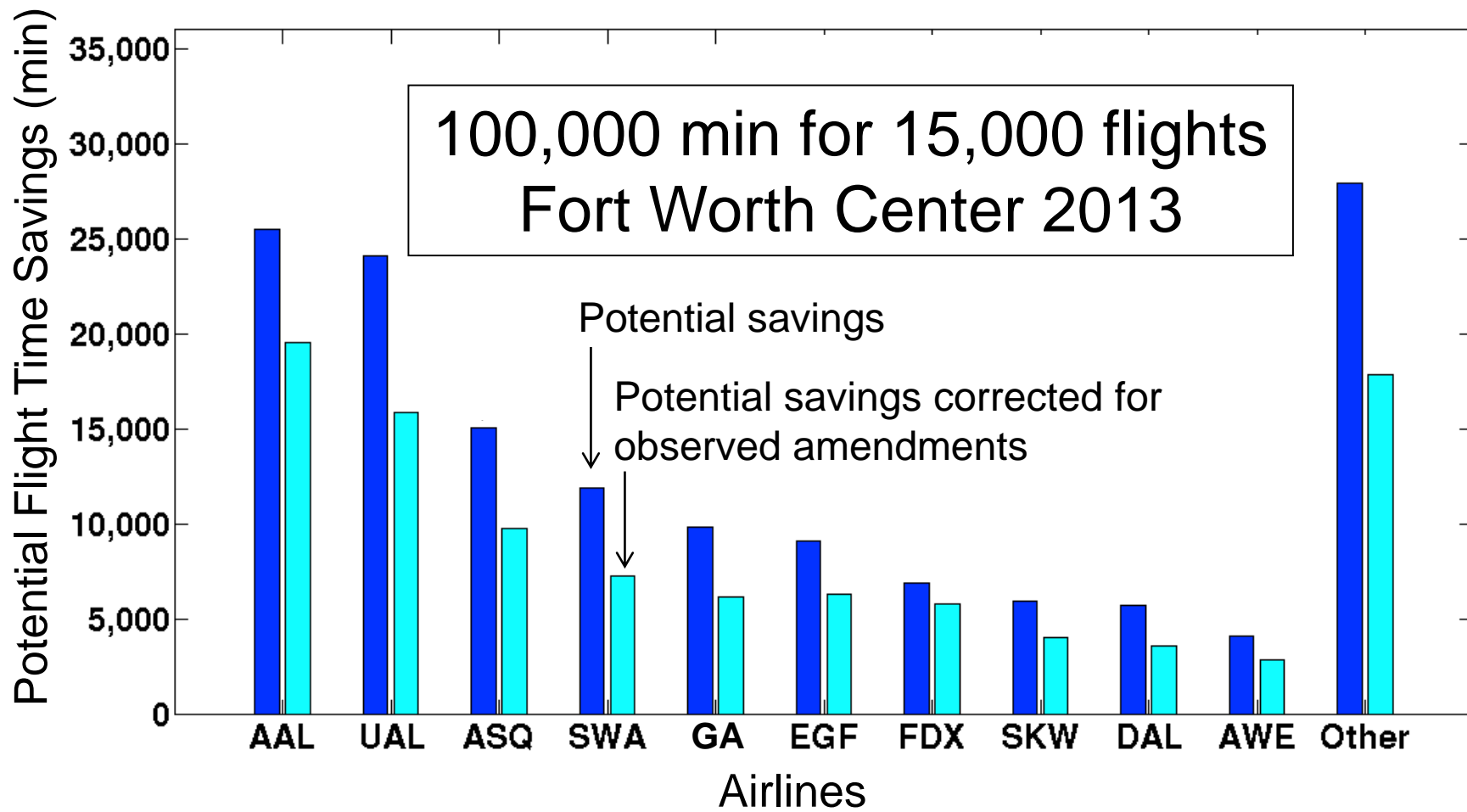


Continuous Automatic Search
Finds High-value Route
Correction Opportunities,
Airborne Flights, En Route
Airspace



Potential Benefits Analysis

All Airlines, All Flights, Fort Worth Center 2013

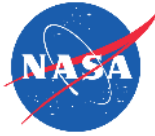


Traffic Aware Strategic Aircrew Requests (TASAR) NASA Flight Deck Application for En Route Flight Optimization

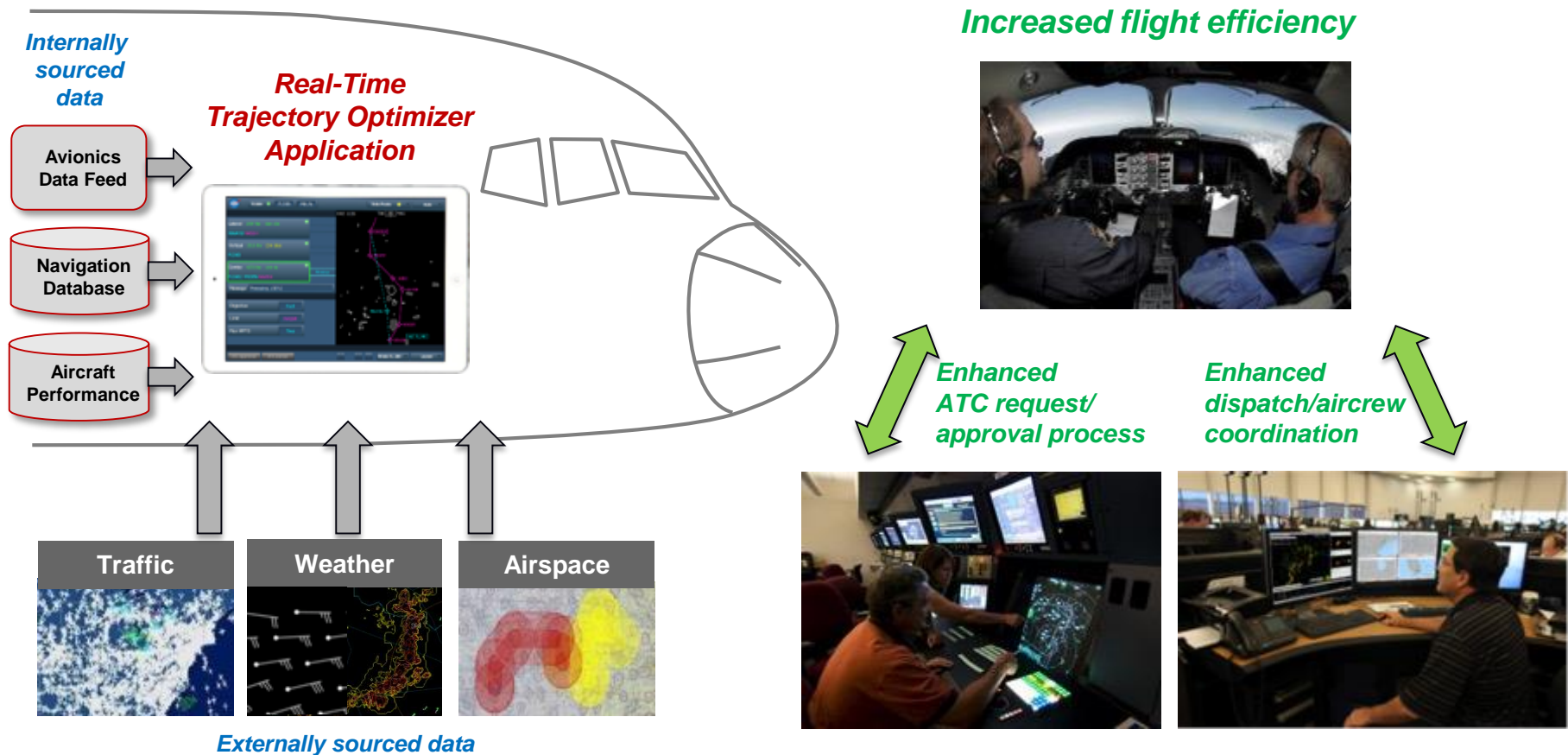


David Wing, TASAR Principal Investigator
NASA Langley Research Center
david.wing@nasa.gov

TASAR Design

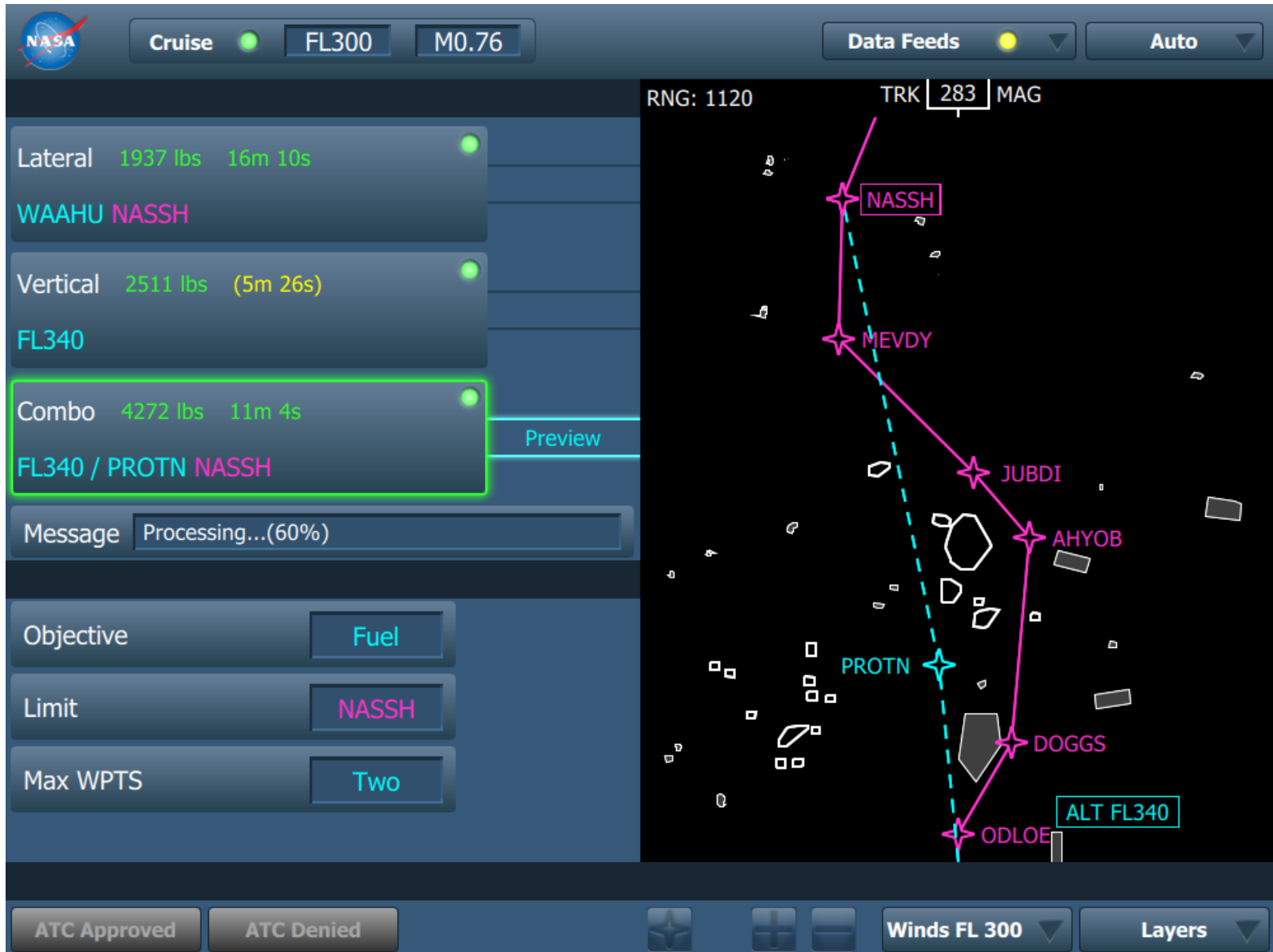


Enhanced User Request Process leveraging **Cockpit Automation** and **Networked Connectivity** to real-time operational data to optimize an aircraft's trajectory en route



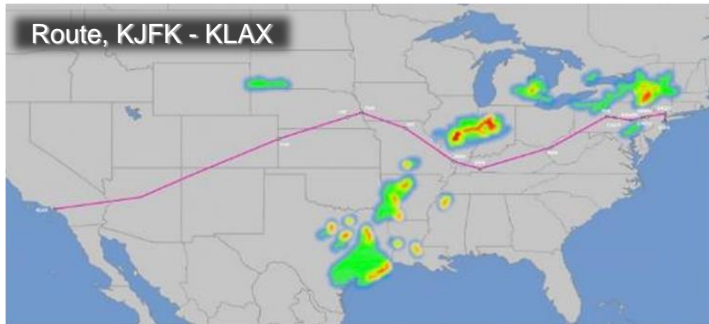
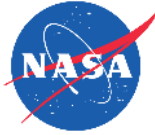
ATC = air traffic control

Traffic Aware Planner (TAP) Auto Mode



Simulation Experiments

Aug 2013, Oct-Nov 2014



- *Fixed-based commercial transport simulator*
- *24 pilots (left seat, pilot flying)*
- *2 simulated flights each, 5-6 use cases*
- *Two HMI designs (separate simulations)*



- *Rigorous human factors experimental design*
- *Evaluated normal and non-normal flight conditions*

Objectives

1. Assess TASAR effect on workload
2. Assess potential interference with primary flight duties
3. Assess TAP HMI design update
4. Assess CBT effectiveness

Two flight trials also completed

Results

1. **No effect on pilot workload compared to standard flight-deck baseline condition**
2. **Non-normal event response not adversely affected**
3. **TAP useful, understandable, intuitive, easy to use**
4. **Standalone CBT was as effective as live instructor**

HMI = human machine Interface

CBT = computer based trainer

U.I. = Operator Performance Lab, Univ. of Iowa



National Aeronautics and Space Administration

Questions?

richard.mogford@nasa.gov

